EXHIBIT I

MAAP-011247

Power Amplifier, 2 W
DC - 22 GHz

Preliminary **- Rev. V1P**

Features

- High Gain: 12 dB
- P1dB: 30 dBm
- P_{SAT}: 33 dBm
- Output IP3: +42 dBm
- Bias Voltage: V_{DD} = 15 V
- Bias Current: I_{DSQ} = 500 mA
- 50 Ω Matched Input / Output
- Temperature Compensated Output Power Detector
- Lead-Free 5 mm 32-lead AQFN Package
- RoHS* Compliant

Description

The MAAP-011247 is a 2 W distributed power amplifier offered in a lead-free 5 mm 32-lead AQFN package. The power amplifier operates from DC to 22 GHz and provides 12 dB of linear gain and 33 dBm of saturated output power. The device is fully matched across the band and includes a temperature compensated output power detector.

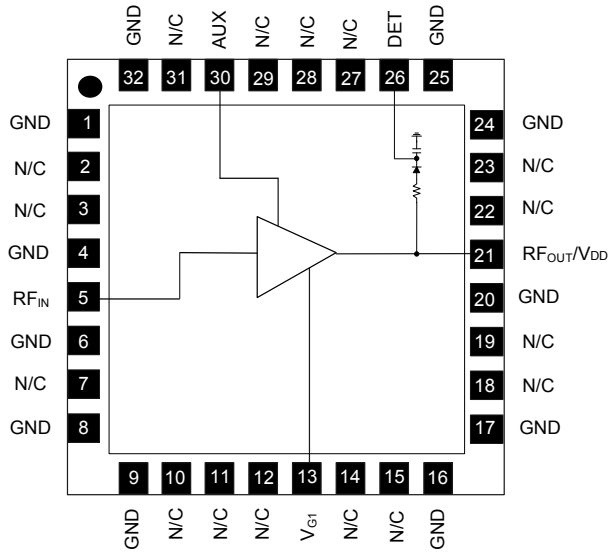
The MAAP-011247 can be used as a power amplifier stage or as a driver stage in higher power applications. This device is ideally suited for test and measurement, EW, ECM, and radar applications.

This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information

Part Number	Package
MAAP-011247-000PPR	Bulk
MAAP-011247-EV1PPR	Sample Board

Functional Schematic



Pin Configuration[1,2]

Pin No.	Pin Name	Description
5	RF_{IN}	RF Input
13	V_{G1}	Gate Voltage
21	RF_{OUT}/V_{DD}	RF Output / Drain Voltage
26	DET	Power Detector
30	AUX	Auxiliary
1, 4, 6, 8, 9, 16, 17, 20, 24, 25, 32	GND	Ground
2, 3, 7, 10 - 12, 14, 15, 18, 19, 22, 23, 27 - 29, 31	N/C	No Connection

1. MACOM recommends connecting all no connection pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

*Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

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Electrical Specifications: T_A = +25°C, V_{DD} = 15 V, I_{DSQ}[3] = 500 mA, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	2 GHz 12 GHz 18 GHz 22 GHz	dB	—	12.0 11.5 12.0 11.5	—
P_{SAT}	2 GHz 12 GHz 18 GHz 22 GHz P_{IN} = +23 dBm	dBm	—	32.0 33.5 33.0 31.0	—
P1dB	2 GHz 12 GHz 18 GHz 22 GHz	dBm	—	30.0 31.0 30.0 28.0	—
OIP3	2 GHz 12 GHz 18 GHz 22 GHz P_{IN} = + 20 dBm/tone (10 MHz Tone Spacing)	dBm	—	42.0 46.0 42.0 44.0	—
PAE	2 GHz 12 GHz 18 GHz 22 GHz P_{IN} = + 23 dBm	%	—	16.5 20.0 17.0 12.0	—
Input Return Loss	P_{IN} = - 20 dBm	dB	—	15	—
Output Return Loss	P_{IN} = - 20 dBm	dB	—	15	—
IDD (with RF drive)	P_{IN} = + 23 dBm	mA	—	600	—
IG1	—	mA	—	8	—

3. Set I_{DSQ} according to bias procedures in page 3.

Maximum Operating Ratings

Parameter	Rating
Input Power	25 dBm
Junction Temperature[4,5]	+150°C
Operating Temperature	-40°C to +85°C

4. Operating at nominal conditions with junction temperature ≤ +150°C will ensure MTTF > 1 x 10^6 hours.
5. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
   Typical thermal resistance (Θ_{JC}) = 7°C/W.
   a) For T_C = +85°C,
   T_J = +145°C @ 15 V, I = 0.69 A, P_{OUT} = 33 dBm, P_{IN} = 23 dBm

Absolute Maximum Ratings[6,7]

Parameter	Absolute Maximum
Input Power	28 dBm
Drain Voltage	+16 V
Gate Voltage	-5 to 0 V
Junction Temperature[8]	+175°C
Storage Temperature	-65°C to +125°C

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.
8. Junction temperature directly effects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime.

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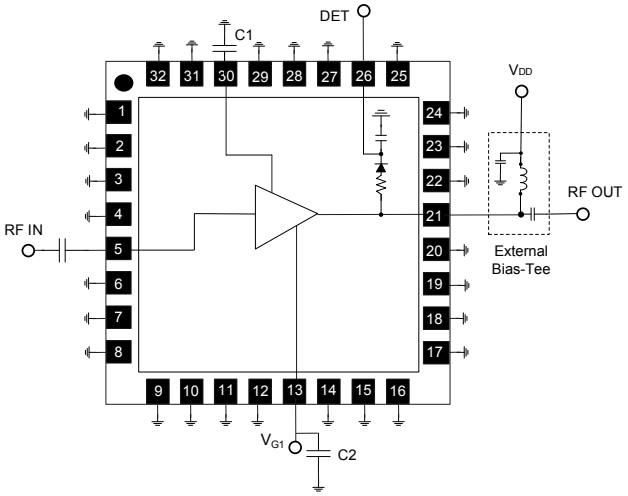
Application Schematic



Bill of Materials[9,10,11]

Part	Value	Size	Comment
C1, C2	1 µF	0402	bypass
U1	—	—	MAAP-011247

9. C1 & C2 are required for operation below 1 GHz.
10. High power external bias tee was used for measurements.
11. External DC block was used on input.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

Operating the MAAP-011247

Turn-on

1. Apply V_{G1} (-4.5 V).
2. Increase V_{DD} to 15 V.
3. Set I_{DSQ} by adjusting V_{G1} more positive (typically -3.4 V for I_{DSQ} = 500 mA).
4. Apply RF_{IN} signal.

Turn-off

1. Remove RF_{IN} signal.
2. Decrease V_{G1} to -4.5 V.
3. Decrease V_{DD} to 0 V.

Biasing Conditions

Recommended biasing conditions are V_{DD} = 15 V, I_{DSQ} = 500 mA (controlled with V_{G1}).

V_{DD} Bias must be applied through a resonant free high inductance on the RF output line.

By-pass capacitor C1 for the auxiliary pad is for low frequency operation extension (below 1 GHz).

Recommended PCB Information

RF input and output are 50 Ω transmission lines. Single layer 8 mil Rogers RO4008 with 1/2 oz. Cu. Use copper filled vias under ground paddle.

Grounding

It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200-µm) diameter vias under the device, assuming an 8-mil (200-µm) thick RF layer to ground.

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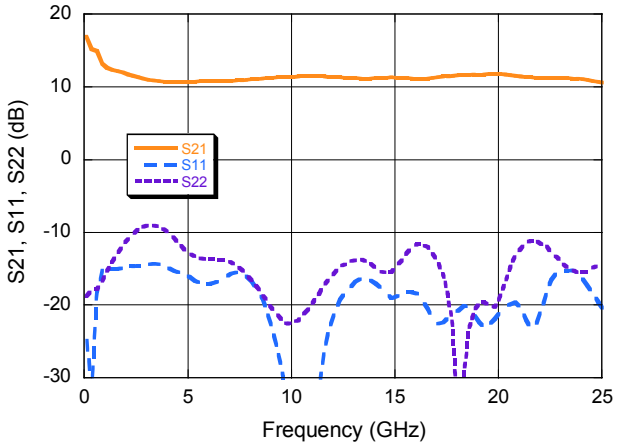
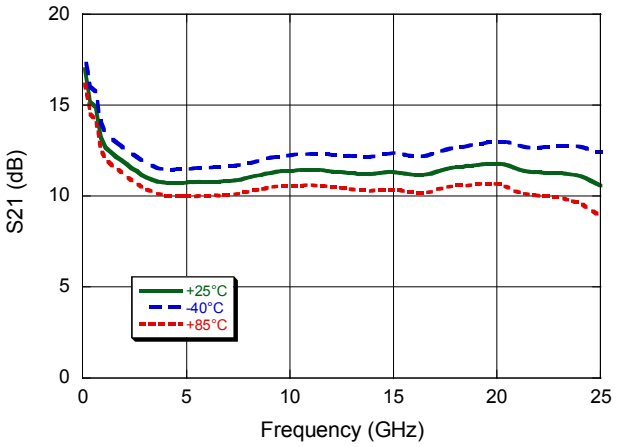
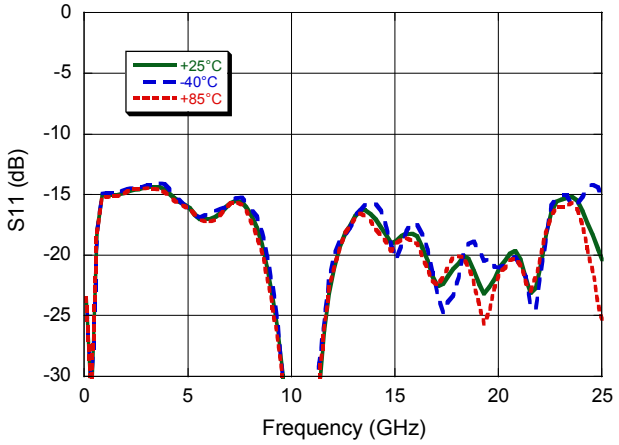
S Parameters



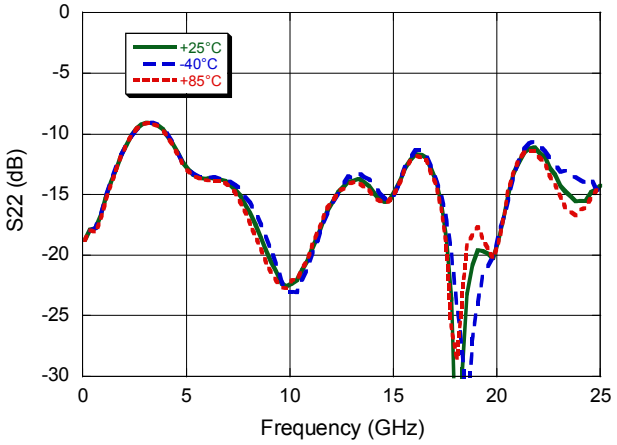
Gain



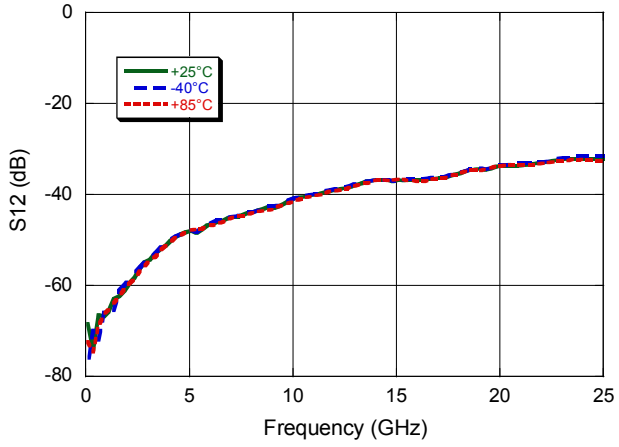
Input Return Loss



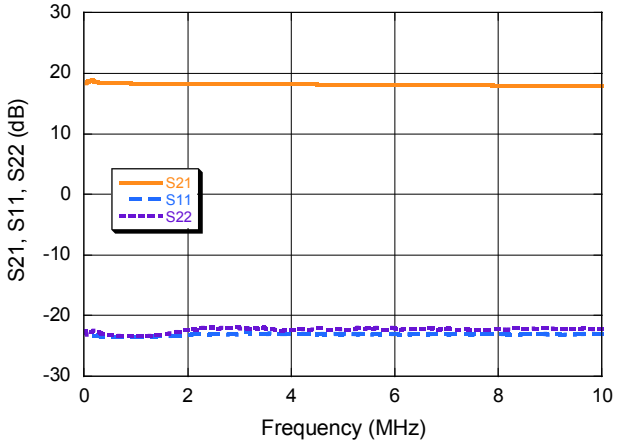
Output Return Loss



Isolation



S Parameters @ Low Frequency



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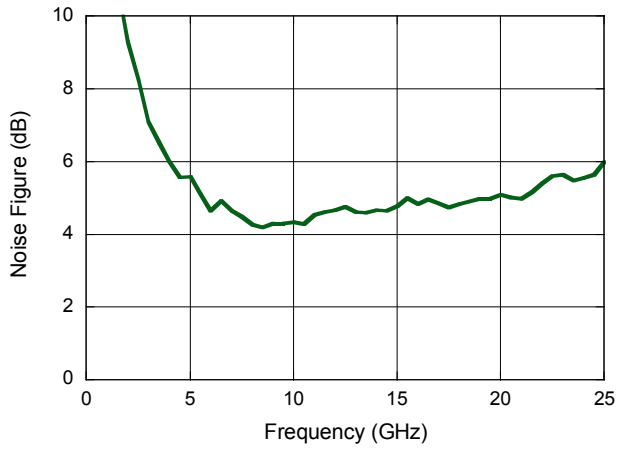
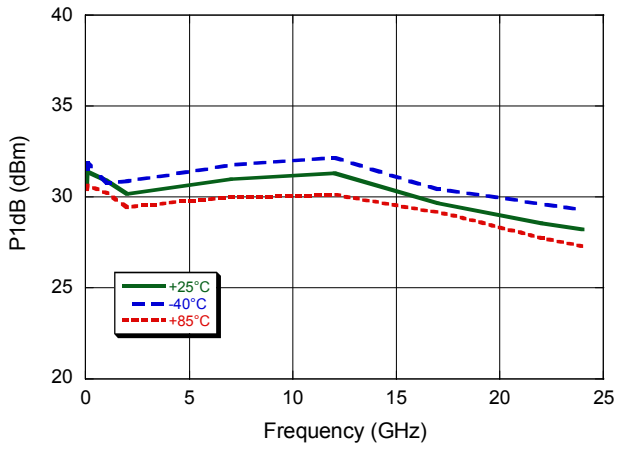
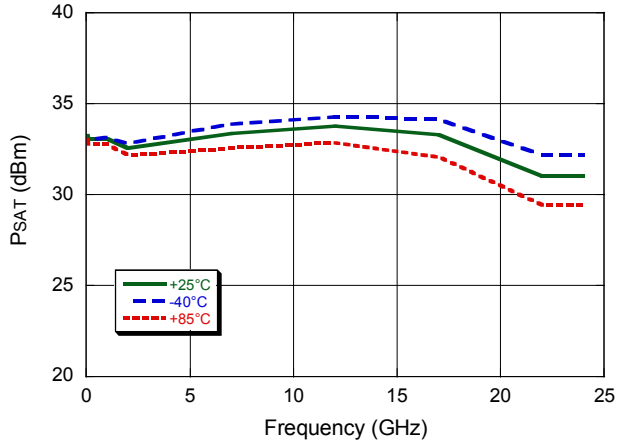
Noise Figure



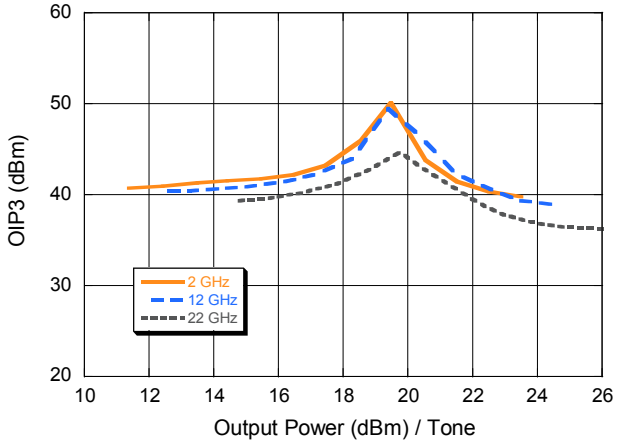
P1dB over Temperature



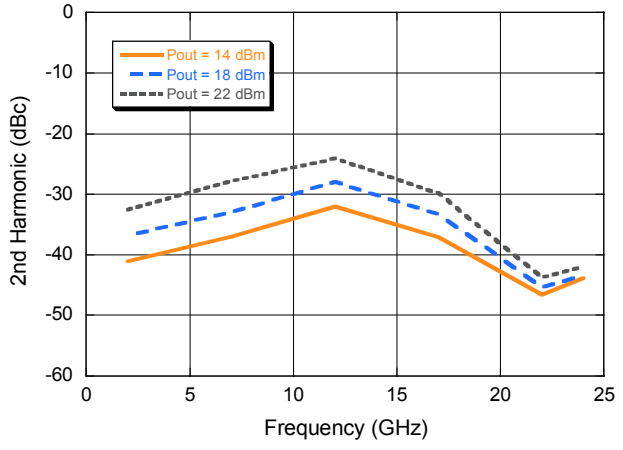
P_{SAT} over Temperature



Output IP3 vs. P_{OUT} / Tone



2nd Harmonic



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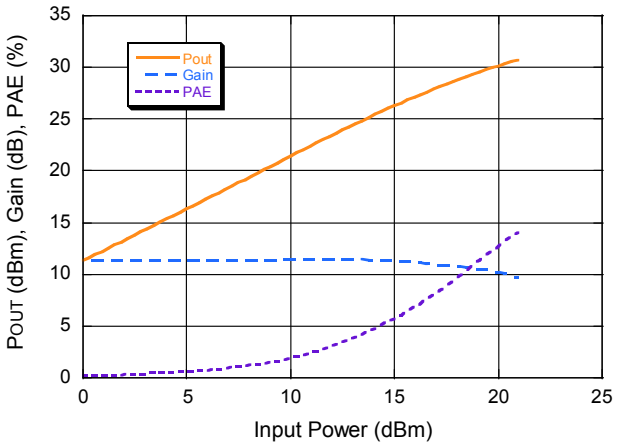
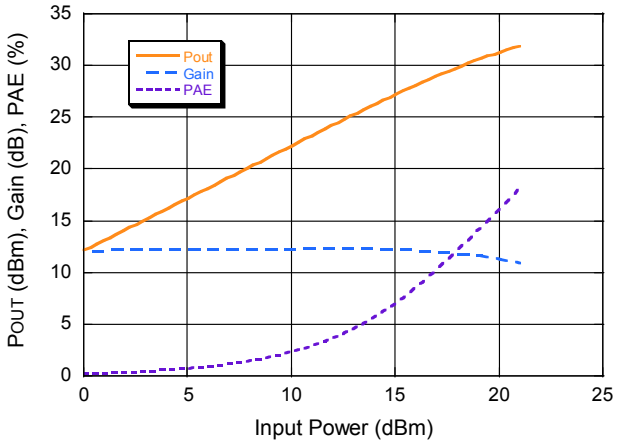
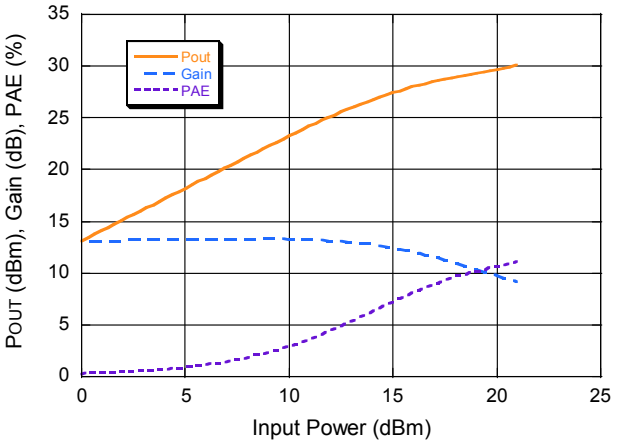
Power Compression @ 2 GHz



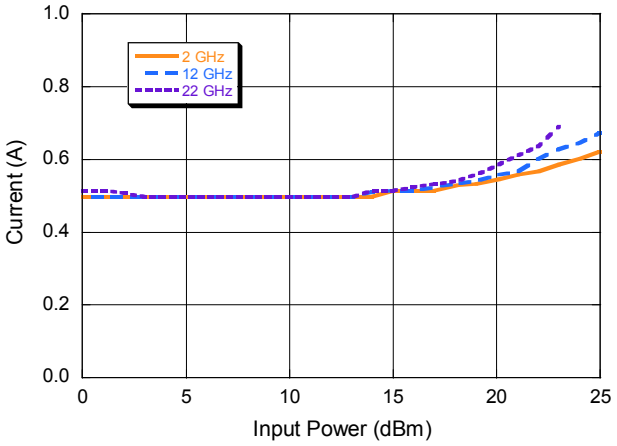
Power Compression @ 12 GHz



Power Compression @ 22 GHz



Current



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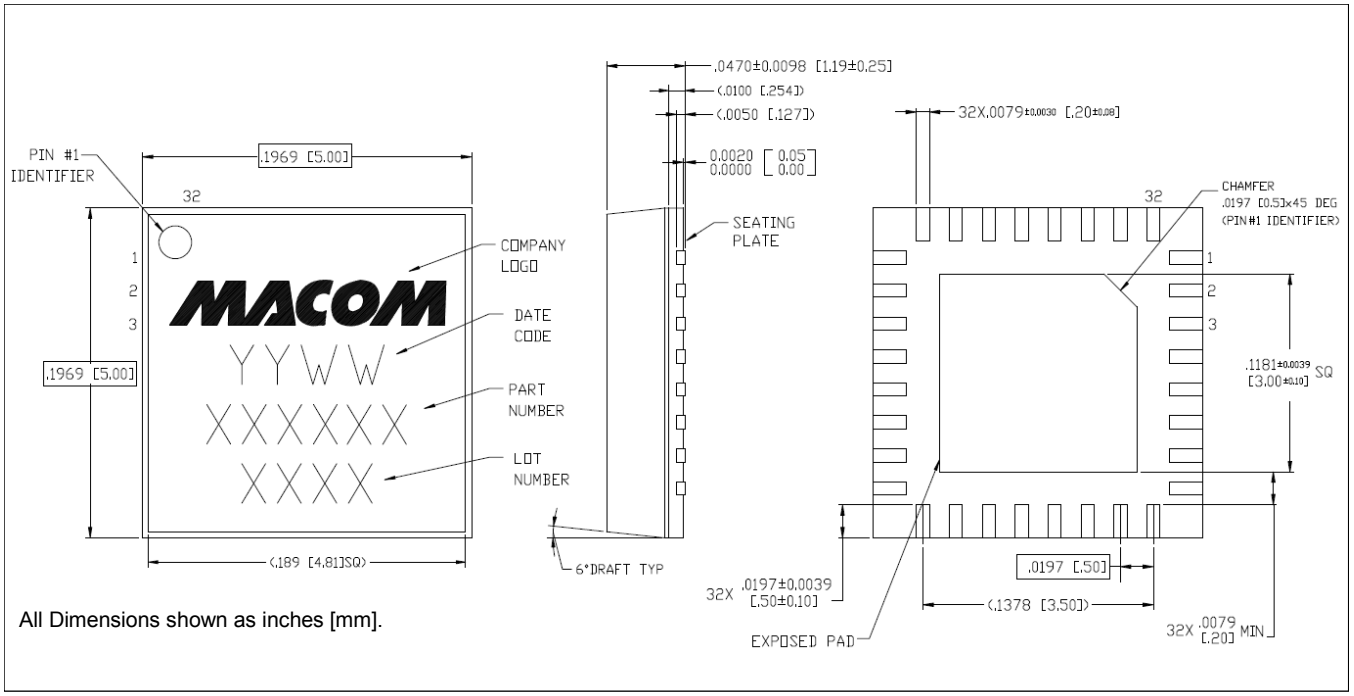
Lead-Free 5 mm 32-lead AQFN Package†



All Dimensions shown as inches [mm].

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAu.

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